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ABSTRACT

This study was conducted in order to explore patterns of teachers' thinking and learning as they learn a new instructional approach. The theoretical framework is based on a model in which teachers: learn and implement a new practice; witness cognitive and attitudinal changes in students' learning outcomes; change their own beliefs and attitudes; and incorporate the new practice. Belief follows practice and observation rather than vice versa. The participants in the study were 21 teachers from 15 school administrative units in New Hampshire. Data sources were journal entries, questionnaires, videotapes of all teachers, and observations of nine teachers' classroom practice. Data indicated that most teachers reported alternating phases of frustration and increased surges of learning at identifiable stress points. All teachers adopted some routine practices of the innovation. Attributes of teachers' attitudes and knowledge changed from the beginning to the end of the institute. However, there was some reversion to an original state by the end of the following academic year. (Author/LL)

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A Staff Development Model for Improvement of Teaching: Practice First and Believe It When You See It

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A Staff Development Model for Improvement of Teaching: Practice First and Believe It When You See It

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ABSTRACT

The purpose of the present study is to explore patterns of teachers' thinking and learning as they learn a new instructional approach. The theoretical frameword is based on Guskey's (1986) "Model of the Process of Teacher Change".[1] According to Guskey's model, teachers learn a new practice, try it out, see changes in student learning outcomes (cognitive or attitudinal), change their beliefs and attitudes, and then incorporate the new practice. Belief follows practice and observation rather than vice versa.

In this study we compare teachers whose beliefs and practice conform or do not conform to the innovative approach introduced by the program developers. We examine the following features of teachers' thinking as the teachers learn about the innovative approach and attempt to implement it:

(1) types and exemplars of beliefs, attitudes, knowledge, and practice in regard to the innovation and
(2) patterns in change and persistence of teachers' beliefs in regard to the innovation.

Participants were 21 teachers from 15 school administrative units in New Hampshire. Data sources were journal entries, questionnaires, and video tapes of all teachers and observations of 9 teachers' classroom practice. During an initial six-week Institute teachers wrote lessons and used them to teach a three-day practicum to small groups of children. They were videotaped during the practice and some received feedback on their performance. Follow-up during the ensuing school year included two one-day workshops, observations of classroom implementation, but no systematic feedback. We traced what teachers said about their experiences as learners throughout a six-week Institute and during the academic year following the Institute, when they implemented an innovative group work model.

Results are reported through rich description for four teachers who represent a spectrum from committed to resistant. Most teachers reported alternating phases of frustration and increased surges of learning at identifiable stress points during the Institute. Those stress points occurred at three times: at the beginning of the workshop; at the time when teachers worked in groups to write discovery-oriented lesson plans; and just before they taught the lessons to students in a three-day practicum. Data indicate that all teachers adopted some routine practices of the innovation. Attributes of teachers' attitudes and knowledge changed from beginning to end of the Institute, but some reverted to the original state by the end of the following academic year.

Implications of the study lead to questions concerning (1) the meaning of apparent surges of learning during the inservice program, (2) possible adaptations of the inservice program to accommodate stress points, (3) the common practice of providing inservice staff development with little or no in-school feedback, and (4) selection of teachers for expensive inservice programs.

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[1] *Guskey, T. (1986). Staff development and the process of teacher change. Educational Researcher, 15(5), 5-12.*

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Change agents and educational program developers often view inservice programs from an instructor's perspective. What if they were to view inservice programs from the perspective of their main clients, classroom teachers? How would they change the inservice programs if they could see what happens in the minds of teachers who contemplate new educational approaches and attempt to implement those approaches in their classrooms? In this study we examine journals and comments made by elementary and junior high school teachers about an inservice program designed to introduce cooperative group work in math and science.

Imagine you are an educational program developer. You introduce a new teaching approach to a group of 21 experienced teachers who have volunteered to try out an innovation. They attend a six-week summer Institute, where you help them design mathematics and science lessons and practice implementing those lessons for small groups of elementary students. You introduce a cooperative group work model, an instructional innovation that has a clear conceptual framework grounded in empirical data supporting its advantages for increasing students' achievement. Some teachers in your audience listen enthusiastically and others yawn. After the first day of the workshop, one teacher writes in her journal:

> I'm excited about the manner in which this class is being taught and that content, teaching ideas, and teaching methods are being combined and modeled.

A second teacher declares cautiously:

> I'm still not sure where the Institute is going or exactly what is expected of me and my fellow teachers. I'm more than willing to continue, with an open mind, to watch things develop over the next week or so.

A more resistant teacher writes:

> Although I enjoy the activities (presented in the workshop), I'm having difficulty bringing all the various concepts to closure. I'm finding it hard to organize all the ideas. I feel more comfortable with fewer shades of grey. The activities do bring to mind long forgotten concepts, but it is still rather confused. I'm definitely a slow learner.

You shrug and silently acknowledge that some teachers will implement the new approach fairly successfully, while others will shelve it. Still others may extract some features from the innovation and may treat those items as optional add-ons to their own standard classroom operating procedures. You wonder whether you should resign yourself to the notion that you

can do nothing to increase the ratio of adopters to shelvers. Historically, inservice programs have changed little of what happens in classrooms (Cohen, 1989). Perhaps teachers will be teachers. Perhaps history will repeat yet again and your innovation will come to little or naught.

Upon closer examination, would teachers' thoughts and reflections on their own learning suggest clues for enhancing their understanding of the theoretical foundations of a complex innovation? Would their self reports and journals provide clues to help you find ways of assisting them for making fundamental changes in their pedagogy?

Summary. The purpose of the present study is to explore patterns of teachers' thinking and learning as they learn a new instructional approach. We compare teachers whose beliefs and implementation conform more and less closely with the innovative approach introduced by the program developers. We examine the following features of teachers' thinking as the teachers learn about the innovative approach and attempt to implement it:

(1) types and exemplars of beliefs, attitudes, knowledge, and practice in regard to the innovation, and

(2) patterns in change and persistence of teachers' beliefs in regard to the innovation.

We traced what teachers said about their experiences as learners throughout a six-week workshop and during the following academic year when they implemented an innovative group work model. Details of the group work model are described in the Methodology section below. During the initial six-week workshop teachers wrote lessons and used them to teach a three-day practicum to small groups of children. Although all the teachers in the study were volunteers, their commitment to adoption of the innovation varied. Evidence indicates that attributes of some teachers' attitudes and knowledge remained constant. Most of the teachers reported alternating phases of frustration and increased surges of learning at stress points during the Institute. Those stress points seemed to occur at three times: at the beginning of the workshop; at the time when teachers were required to write lesson plans; and just before they taught lessons to students in a three-day practicum. Changes in teachers' thinking were not fully maintained after a year of practice. Implications of the study lead us to speculate about (1) selection of teachers for expensive inservice programs (for which resources are scarce), (2) the meaning of apparent surges of learning during the inservice program, (3) possible adaptations of the inservice program to accommodate stress points, and (4) the common practice of providing inservice staff development with little or no feedback on teachers' subsequent classroom performance.

Theoretical Framework

Classic models of staff development propose that changes in teachers' beliefs, attitudes, and knowledge will lead to changes in classroom practices (Lewin, 1935; Berman & McLaughlin, 1977; McLaughlin & Marsh, 1978; Guskey, 1986). Recent works suggest that

teachers learn and benefit from reflection on practice, role restructuring, collegial collaboration, and supported inquiry (Ellis, 1990; Holmes Group, 1990; Smylie, 1988; Oja & Pine, 1987; Little, 1982; Cohen, 1981). Guskey (1986) proposes an alternative "Model of the Process of Teacher Change," which acknowledges the staff development elements listed above but posits a different temporal order. Guskey accepts the premises that (1)teachers are intrinsically motivated to improve their teaching and (2)teachers look for expected student outcomes as determinants of success. According to Guskey's model, teachers learn a new practice, try it out, see changes in student learning outcomes (cognitive or attitudinal), change their beliefs and attitudes, and then incorporate the new practice. Belief follows practice and observation rather than vice versa. Teachers whose beliefs and assumptions are in conflict with premises on which the innovative model is based may resist assuming a new teaching role, even when success is observed in practice.

For the present study, a model similar to Guskey's process model was considered in planning the staff development intervention and interpreting results. The researchers' judgments about the relevance of the model and the relative contributory weights of each staff development element were suspended until data were analyzed.

Methodology

The innovation introduced to teachers in this study is Complex Instruction, a pedagogical model of group work designed to offer opportunities for concept development and problem solving. Along with the pedagogical model, instruction in mathematics and science content was provided. Mathematics and science were considered to be domains of inquiry with intrinsic intellectual value. The group work design of Complex Instruction was well suited for the content because it required students to talk and work together, collaborating to find and solve problems. Although group tasks were open ended and had many possible solutions, each student was held accountable for knowledge attained. Teachers were required to refrain from giving direct help and providing answers. Instead, they tried to stimulate students' thinking, extend activities, give specific feedback, and recognize multiple abilities displayed by students. In this model the teacher is a guide for learning rather than a director.

Theory and a practicum were incorporated for teachers in an initial six-week summer Institute that included instruction in group work and specific science and math content. For the Institute's practicum, each teacher worked with a team that presented their lessons to three different groups of students. During the following year, teachers' classroom practice was interspersed with two one-day inservice workshops where teachers reviewed pedagogical theory of group work.

The group work approach presented to teachers was modeled after that developed at Stanford University and described by E.G. Cohen in her book, Designing Groupwork (1986). Conceptual tasks are designed for students to talk and work together in ways that assist them in understanding and applying ideas. Students work in groups small enough so that everyone can

participate on a task without direct and immediate supervision by a teacher. One key feature of group work is that teachers delegate their own authority by allowing students to make mistakes and struggle on their own. The teacher does not tell students what their task is or monitor to correct errors right away. Even if the teacher assigns a task to the group and waits nearby, "hovering" to make certain that students are on task, that teacher has not delegated authority to the students. A second key feature of group work is that members of the group need each other to some degree to complete their task. Students in successful groups will often ask one another questions, explain, make suggestions, criticize, listen, agree, disagree, assist one another, and make joint decisions.

Teachers prepare students for group work by helping them establish norms for cooperation. It is especially important that students learn how to help one another without giving "right answers." Cohen suggests that teachers assign heterogeneous groups and specific roles to group members.

The teacher's role in group work is dramatically different from that played in direct supervision. In group work the teacher gives students feedback, redirects with open-ended questions, encourages groups to solve their own problems, extends activities, encourages thinking, and supplies resources. Status problems must be checked and controlled so that some children do not dominate. Students' multiple abilities are elicited and valued. The group work teacher refrains from direct supervisory strategies such as lecturing, instructing, telling students how to do a task, disciplining, working with only one group, and leading discussions. Most teachers are accustomed to leading students by directly instructing, correcting errors immediately, and not allowing students time to struggle and solve challenging problems. Thus, the novice group work teacher may encounter difficulties adopting a vision of knowledge as inquiry, as well as playing a new teaching role.

Participants. Twenty-one volunteer elementary and junior high teachers were selected to attend a six-week Institute on the basis of several criteria: district commitment and support for release time for participants to present local teacher workshops on the Institute; district support for teaching teams to attend the workshop; recommendations by principals regarding teachers' leadership potential; and teachers' demonstrated interest in teaching math and science. The teachers were from 15 School Administrative Units in the Northeast. Recruiting literature advertized the Institute in the following manner:

> The Institute is a six-week long series of activities, lecture/discussions, laboratories, and field experiences to prepare selected elementary teachers as mathematics and science specialists. Hands-on workshops will integrate mathematics and science. Energy will serve as a unifying theme to explore physical science concepts. The mathematical emphasis will be on quantitative reasoning. We will develop cooperative learning and discovery strategies for teaching in these areas. We will produce methods and materials for classroom use and for conducting staff development workshops during the school year in local districts. The program will include a chance to work with elementary students

in testing new strategies.

The Institute staff consisted of members of the Departments of Education, Mathematics, Physics, and Chemistry at the University of New Hampshire. Sessions were presented on theories and practice of group work and discovery learning, along with sessions on math and science content. Most of the content sessions were designed to involve teachers as students participating in group work and discovery learning, thereby modeling the new pedagogy. Teachers worked in small groups to design tasks and materials in science and math for a three-day practicum with elementary students near the end of the Institute.

Most of the teachers attended two follow-up workshops presented by the original Institute staff in October and March during the year following the Institute. Teachers received information and some feedback on their practicum experiences during the Institute, but no resources were available to provide observation and feedback for them in their classrooms during the first year of implementation. In common practice, observation and feedback are rarely provided because of a lack of funds in most districts. Observation and feedback are not usually seen as priorities unless a teacher is having difficulty. Although all of the teachers paired up at the Institute and promised to observe one another during the year, in reality none were able to obtain release time to do so.

Data sources. Teachers wrote journals nearly every day of the Institute. Many journals were written freely. Questionnaires were administered at the beginning and end of the summer Institute, in October, and in March. Nine of the teachers were observed and interviewed by trained observers at the end of the first year of implementation. Training for classroom observers included watching video tapes of teachers and practicing scoring teaching behaviors until they reached reliability with one of the principal investigators. Two researchers each read all of the journals and reached agreement on their interpretation.

Results.

We report results for four teachers who represent typical levels of sophistication in knowledge about the group work model and various amounts of expertise in classroom implementation of the model. Kate and Dee were top performers in the practicum and in their classrooms. Kate reported many changes in her beliefs and attitudes about cooperative group work. Dee came to the Institute with some knowledge and experience about group work, and she maintained her enthusiasm and expertise but changed less than Kate. Fred was cautiously skeptical, but he adopted some of the routines for cooperative group work and became more enthusiastic as he gained experience. Sally was quietly resistant from the beginning of the workshop through the end of the following academic year. Although she used many of the routines prescribed for group work, she maintained a directive approach to teaching and did not believe that her students would learn by talking and working together.

Kate. At the beginning of the Institute, Kate was apprehensive and enthusiastic. Her focus was

mainly on her own weaknesses in the content areas of science and math. On the first day she wrote:

> I came to this workshop excited about the possibility of gathering information and ideas that would help me to improve science in my classroom and very nervous that my weaknesses in math and science would interfere with my getting the most out of the Institute. (6/26)

> I'm still not sure where the Institute is going or exactly what is expected of me and my fellow teachers. I'm more than willing to continue, with an open mind, to watch things develop over the next week or so. (6/26)

Two days later she confidently set some goals in math and science and wondered why her teachers had failed her when she was a student. She entertained the notion that she might improve her knowledge of collaborative learning:

> One of my goals for the Institute is to improve my knowledge of energy and physics. It would be wonderful if I could go back to elementary at school and learn all the concepts that I missed the first time through. (Did I miss them or were they simply not presented in a way I could relate to? Probably a combination of both.) I would like to increase my knowledge of collaborative learning so that I can use it even more in my classroom. (6/28)

She began to described herself as a learner, learning from peers, on the fourth day of the Institute:

> I was sometimes frustrated (especially during the mirror/reflection experiment). I wanted the "teacher" to give me the answer, but by working with the materials beyond the "obvious," with guided instruction from the "expert," I really felt better about myself and my discoveries. Oh, how important it is to give our students these opportunities, but oh, how hard it is to stop being "the teacher." (6/30)

Kate experienced frustration when she began to grapple with science concepts for which she lacked adequate background. She tried to pry information from family members;

> The Institute has stimulated some interesting dinner conversations at my house. The male members of my family felt I lacked the ability to understand science or math, so I love coming home with problems that challenge them to be able to explain different concepts to me. (7/6)

> My home tutors failed me last night. Eldest son threw his hands up in the air and walked away mumbling, "How can I teach you something that's so obvious?" (That kid definitely ain't "teacher material.") Husband held in there longer and cleared away a few

of the clouds but he was lost without the math so I figured that they didn't understand my learning style so I read the chapter on friction and machines in Science for the Elementary School which eliminated a few more of the clouds. My understanding of the concepts of "velocity, acceleration, impulse and momentum" is still quite "shaky." (7/10)

Each day a few more of the cobwebs are being eliminated - or at least jumbled around! (7/10)

As Kate worked with other participants at the Institute to prepare a group work project, she reported her new understanding and synthesis of cooperative group work, discovery learning, and content information. As time went on and the project unfolded, Kate became more reflective and more frustrated. Her level of understanding grew more sophisticated as she applied theory to planning:

Finding the framework, cooperative learning, made it easier for us to get a "grip" on our project. I really felt that discovery learning and group work go hand in hand so when we have to give workshops our emphasis will be on teaching science through discovery and group learning. We chose electricity as our content theme since it's the area that we know the least about. (7/7)

Finally, we hope to set up the project in such a way that the activities can be cut out, pasted on a large index card, laminated, and used in the classroom. Our project will meet three needs: (1) to give workshops, (2) to learn more about electricity, and (3) to have activities that can be used in the classroom. Not bad for one project! (7/7)

I spent last night reevaluating my thoughts on discovery learning versus teaching the content. My science education stressed content, content, content. Many of the things I was asked to memorize were things that could easily be found in any chemistry, physics, or biology book. ..I have to assume that a strong emphasis on content is probably not the best way to learn. I do a lot of discovery learning in reading and writing so why am I having difficulty grasping discovery learning in science? Perhaps I need to evaluate what concepts are truly important in each content area. Is that concept something a child can use in other areas or is it just a piece of information with a "so what" tag on it? The teacher really needs to know the objectives and design activities that will lead children to discovering the concept and then helping him or her with the specialized vocabulary first. (7/13)

I'm having a great deal of trouble separating the "noisy" attributes from the real attributes. I realize that there seems to be a definite lack of continuity in the elementary science curriculum. I think I'm having trouble getting a real handle on our module because I can't seem to define my objectives. What do I hope my students will "get" from each science experience? I often leave our project sessions very frustrated. (7/17)

As the practicum drew near, Kate anticipated the experience with optimism:

> I hope that we will be able to observe cooperative learning interactions among the children. The cooperative learning mode would certainly promote more "problem solving" type activities and remove the emphasis on children doing "a daily dose of dittos" or workbook pages during math time. (7/19)

After the practicum, Kate reflected on her own learning and results of the experience of teaching children:

> The last two days have really been a learning experience for me. I got jolted back to the reality of how young beginning second graders are and what I'll be facing in six short weeks! It was really amazing to realize that not only was I going to have to teach my children how to behave in cooperative groups, but that I had to do some serious retraining myself. I am really looking forward to having cooperative groups in my class next year. I have been doing cooperative learning in an informal way for some time now and realize its value. It will be fun to do it using my new found skills. It's not easy leaving a group alone to develop its own dynamics. I think having only one group to work with makes this hard; you so desperately want to jump in to "guide" them in the right direction; to handle all domestic problems. Hopefully managing four or five groups next year will help me to get less involved, so that the children will talk more with each other than with me. (7/27)

> As to discovery science; I had a very difficult time leaving the salt and pepper experiment without a conclusion. They (the children) seemed to have exhausted all their possibilities and were tiring of the activity. I hoped that what they would learn in the puffed rice activity would give them the solution to the salt and paper problem. The second graders were content to solve the problem unsolved, the fourth grade girls were not, but were willing to wait to see if they could find a solution later. A big dilemma that we faced the first day was in the final debriefing. The children had concluded that gravity was the reason that t the different materials stuck to the spoons. When I asked them what gravity made things do, they all answered, "Fall to the ground." "Then how come the pieces of paper went up?" I asked. "That's because you got rid of gravity," they chimed in. This was one of the problems I have wrested with for most of the Institute. Should I leave this misconception stand or try to clarify it? With my own class I would have probably left it alone for a few days, hoping with further experimentation they would come up with another answer. With this group we talked through some of their ideas and vaguely got to the idea of "people electricity." I noticed that when they were working with the "magnet" group they were still using their gravity theory to explain magnets, so I probably should have left their original theory alone. (Another valuable learning experience for me!) (7/27)

A few days later, after more reflection; Kate recorded more thoughts about herself as a

learner, as a group member, and as a teacher using group work:

> I learned a great deal about myself as a learner and as a teacher during this Institute. I discovered that I learn best when I have the opportunity to work with other people about my discoveries and conclusions. (8/3)

> This Institute has helped to reinforce the benefits of group learning. It has given me concrete ways to help Institute group work into my classroom next year. The practicum gave me the opportunity to look at myself as a teacher, to see what skills I must work on in order to be a good guide and facilitator during group work and, during discovery situations, how to ask divergent questions. (8/3)

At the end of the summer Institute, Kate was asked to describe a classroom environment that promotes learning. In her response she focused on the teacher's role:

> A classroom that promotes children becoming independent learners; that gives them the opportunity to explore their own questions. A classroom where the teacher is the facilitator and not the dictator. Group work would be encouraged.

She was asked the same question seven months later, in March. At this time she answered more specifically than before and focused on students' activities in group work:

> I think it is very important for students to be encouraged to talk, plan, discuss and disagree I also think it is important that they be taught the social skills necessary to engage in these activities in a constructive manner. Children should also be presented with problems and activities that go beyond "reciting back facts." Ones where process is encouraged over product.

Kate was asked to enumerate the advantages of students' talking and working together. Prior to the Institute (in June), she answered:

> That way the teacher isn't responsible for all the learning that takes place. The children share their discoveries with each other. More exciting and dynamic. Less teacher directed.

At the end of the Institute (August), her answer was:

> They can share ideas and find more than one solution to a problem. Encourages them to verbalize their ideas.

Again, the following March, her response was:

> Children can share ideas and solve problems without having to run to the teacher. They

> teach and learn from each other. They can often help each other better than the teacher can.

Then Kate was asked to name the disadvantages of students' talking and working together. Her answer in June, before the Institute:

> It's definitely a noisier classroom.

In August, following the Institute:

> A much noisier classroom; children need training in group work; children sometimes just give the answers to group members, instead of helping them to see the answers.

The following March:

> It can sometimes be a noisy classroom but the advantages far outweigh the disadvantages.

Kate's answers show more commitment to group work and understanding of its principles in March (the year following the Institute), after implementation in the classroom, than they did immediately after the Institute, in August. She reported an awareness of many changes she had made over the year. She attributed some of the insights to a video tape that had been made of her teaching during the practicum at the Institute. Another video tape was made in her classroom while she implemented a group work lesson in May, nearly a full year following the Institute. After she received feedback on that video tape she reported that she gained new insights about her "hovering" and directive behaviors. She routinely assigned roles to group members. She was pleased to see herself giving specific feedback to several children. In May, the year following the Institute, she reported having had more success with the less capable students:

> They seem to work very well in the cooperative groups. The more capable students seem to be willing to help adjust the activities to meet the needs of these students. They help with the reading and make sure the less capable know what's happening. (5/90)

Although Kate was still working to improve her group work strategies at the end of the first year, the video tapes showed she had improved markedly between the end of the Institute and May, nine months later. Her knowledge of group work and her commitment to its use had increased after she perceived success with students.

Dee. Dee began the Institute with a positive outlook, some insight about herself as a learner, and experience with cooperative learning:

> I was impressed today with the size of the staff and the apparent willingness to help answer questions and interact with Institute members. I find myself anxious to get on

with the program, to get involved with materials. As is often the case when I am the student, I am fascinated to change places with my kids. To see that I don't always listen carefully to directions; I can be impatient to express my opinion and I can feel happy, excited, scared, reluctant, etc.(6/26)

Dee comments on the cooperative learning focus of the Institute and her expectations upon completing the program:

> I was pleasantly surprised by the emphasis on cooperative learning. It is something that I use in my class but would like to know a whole lot more about as well as share opinions with others...I am interested in ways to work with heterogeneous groupings in math and science (with possible implications for other areas). This year I will be mainstreaming two children into a regular class for the first time. They have very low skill levels and have learned to be quite dependent.

Since Dee has already used cooperative group techniques, she expects to refine her techniques as a result of what she learns in the Institute. The comments in her journal are reflective and reactive. She responds to experiences at a high analytical level, higher than many of her peers, yet the "phases" that participants moved through during the Institute are as apparent in Dee's entries as they are in Kate's, Fred's, Sally's, or those of the other participants. Those phases were marked by periods of stress preceding self-reports of learning. Roughly, the phases were: (1) initial interest, feelings of inadequacy to cope with science and mathematics content, enthusiasm as they began to work with groups on instructional project applying group work principles to content; (2) description of themselves working in groups with worry and confusion about the group project with later confidence in the group project and their lesson plans as they unfolded; and (3) anticipation of the practicum followed by nervousness about relinquishing teacher control, reaction to implementation, some level of understanding about the knowledge base and techniques for group work.

As the activities of the Institute begin, Dee comments on how participants work through various activities in groups. As is typical of Dee, she considers her present experience in light of working with children in her own classroom:

> It helps to rotate the groups so that when we do different experiments we have the experience of people who worked in different areas the day before...I think we need to accept the idea that we may not have all of the answers for kids and that is okay as long as we can look for answers together. I learned this personally in teaching Logo on computers...I totally buy heterogeneous groups and student talk to create student knowledge. (6/28) Dee goes on to describe her success in the classroom with random groupings, rotated weekly. She is reluctant to use such groupings for teaching mathematics because some children have great difficulty understanding math concepts and do not seem to learn them from other children.

On Friday night of the first week, Dee picked up her husband at the airport and spent the hour and a half car ride to their home telling him about the week:

> He may have done better with daily doses...I couldn't help myself. I was full of it. I told him about energy, light, colors, shadows, experiments, predictions, successes, possibilities, and challenges. The more I talked the more I discovered what I learned. You (collectively) achieved what I as a teacher constantly strive for - you stimulate my interest and involvement outside the classroom. That doubles the effectiveness of classroom time.(6/30)

The following week, Dee felt "overloaded" by information.

> I am concerned that we are so driven by 'content' but not by philosophical or methodological underpinnings. I'll think on this, this weekend. (7/7)

Two days later, Dee feels the need for her group to focus on their project development and stop gathering resources. She also thinks about her role in helping teachers at her school by offering a workshop:

> I feel that my workshop needs to focus on cooperative discovery and scientific process methods that are demonstrated within the context of math and science content activities. I think it will be important to discuss observations, assessments, concept development, and ways to handle misinformation so that it becomes a stepping stone to a fuller understanding rather than a dead ended wrong turn. Although my "content" knowledge has increased greatly, I see myself as a "content expert" only by comparison to where I was or some of my peers are. I can see myself becoming an expert in making science and math work in the classroom, which will be of much more use (in a broad sense) to those around me back at school.(7/9)

Toward the end of the third week, Dee still feels a bit overwhelmed by the amount of information she is learning, but begins to be more confident that her group can develop a good project:

> I feel better about our group project. I think our ideas are coming together with thanks to Tim for listening to our thoughts.(7/11)
>
> (Tim was a mathematics education graduate student who was part of the Institute staff)

The next day she gains more insight about group work:

> What a full and wonderful day. This morning's activities were exciting and challenging. They left me excited as a learner and wanting to do more. Cooperative

> learning certainly forces participation. I can tell the difference in my own involvement with a group of two and a group of four. I think that it would really help students to shift group size, as well as to work in situations without assigned roles. (7/12)

Shortly before the participants are to carry out their projects with children, Dee describes disagreement in the group about the role of cooperative learning in the project:

> I still feel ambiguous about the place of cooperative learning in our plan. We felt that it was of major importance - possibly more important than our content focus. Yesterday, in talking to Ellen, she felt it should be more of a demonstration and not actual focus. I wonder how other groups are dealing with this?

The dilemma is typical: this is a great deal of content to cover, it is new to the children, perhaps it is more efficient to use a lecture/demonstration method rather than cooperative group techniques. It is difficult for teachers to believe that, given appropriate materials and gentle guidance, children can construct accurate explanatory notions of scientific phenomena which translates into attainment of concepts. It is interesting that even a self-avowed cooperative learning advocate raises this dilemma as she is about to work with children.

Toward the end of the Institute, Dee makes a recommendation about the teaching of cooperative learning:

> I would also like to see more time for small group debriefing or discussion. We have a large enough staff that we could have a staff member in each group of 4-6. I think a number of participants have experience or reservations about cooperative learning, discovery learning, constructivist approach, student observation technique, record keeping, etc. I hate to think we will miss out on that information. (7/19)

When the children finally came, Dee and others wanted more time to implement their group projects with the children:

> We need time to share our child watching! I think we are learning a lot about cooperative learning, about kids interacting and about our jobs as teachers. Perhaps a discussion with two groups and one staff member would give us a good chance to talk things through. This would also give us a chance to share in depth with another group. (7/26)

Another insightful observation the next day upon viewing the videotape of the projects implemented with children:

> I was struck by the importance of "setting task." We want space for discovery and

> free exploration, but we also have some agenda. The challenge becomes to set the task (through choice of materials, group size and structure, and expectations for sharing, reporting, recording, etc.) so that it gives freedom and focus.

In her critique at the end of the Institute, Dee once again emphasizes the importance of discussion of experiences and philosophies:

> I thought that we were presented with a good overview of Discovery Learning and one model of Cooperative Group Learning. After the models were presented I would have liked to have had more small group discussion and sharing. I think that many of us have had some experience in both of these areas, and this experience was not tapped except in nightly journal. I often felt that I shared more, and interacted more with staff than with peers...I felt that we tiptoed around philosophy and theory which should be at the base of all. The bottom line is how we believe children learn...I think that my frustration comes from my feeling that these ideas are probably ones shared by the staff, but not overtly expressed.

Because of Dee's initial commitment to cooperative learning and process-oriented teaching (which she brought to the Institute), her internalization of experiences occurred at a higher level, and she wanted more -- a refinement of technique, an explication of theory and philosophy of education. She identified more readily with staff than with peers and sometimes was unsure of the role she should play in her own group. She acknowledged that she was "changing places with her students" during the Institute and sought a higher level discussion of that phenomenon as it might relate to classroom teaching. Self-reporting questionnaire data collected at the end of the Institute indicated that Dee had a superior understanding of Institute goals, that she was extremely comfortable when her students talked and worked together, that she believed a teacher can most effectively increase students' knowledge through asking open-ended questions and attempting to stimulate students' own thinking. Dee perceived herself as using cooperative learning techniques often in her classroom without needing the support of aides, other teachers, or Institute staff. (There was, however, a graduate-level teaching intern in Dee's classroom.) Dee's pre-Institute questionnaire responses in these areas were almost identical. The pre-post differences show up in open-ended questions where she displays a level of refinement at the end of the Institute of her earlier beliefs. For example, prior to the Institute, when describing a classroom environment that would promote students' cognitive or intellectual development, Dee writes:

> The class needs time for doing and a time for talking, so that everyone has a real life experience to share and other students/teachers to learn from.

Immediately following the Institute, in answer to the same question, she writes:

> An environment with many open ended activities that respects individual differences

where a variety of mixed ability groupings are employed.

There is a shift in her responses from "I" to "they." At the end of the Institute she writes about giving responsibility to students (rather than just "expecting" it) including evaluation of their own learning. She is more aware of ways in which cooperative learning can help individual students who may not be successful in school. In October, Dee reported that children had a better understanding of each others' strengths as a result of cooperative groupings. In the spring, following the summer Institute, Dee reported that she discussed cooperative learning with colleagues at regularly scheduled meetings from 1 to 5 times per month, although she perceived this as "not often enough." She had not, however, been able to observe other teachers. A field observation by an impartial, trained observer confirmed that Dee is using a sophisticated model of cooperative learning in which children have defined roles, and the spirit of cooperation is openly discussed. During the observation, Dee spent more time asking questions (both divergent and convergent) than she did giving information.

Fred. Fred was comfortable from the first day of the Institute, commenting that the "people involved in putting the program on were there talking and sitting down with the participants not, for the most part, sitting or standing off talking to themselves." In terms of expectations, Fred writes:

> Basically I would like to have some general areas of weakness identified. These areas should receive a good chunk of content focused on them and then we should be able to figure out ways to bring them into the classroom. (6/26)

The next day Fred acknowledged a weakness:

> I'm always looking for or expecting closed activities. This activity served an important service for me in bringing this bit of information to my attention. Someone mentioned in class the fact that as teachers we expect a right answer...oh how wrong that is... (6/28)

At the start, he has a positive attitude toward cooperative learning but is unclear about what it means:

> The Cooperative Grouping is the style which will bring about the most learning. Even if the content is later forgotten, the interaction and cooperation is well worth the extra work involved in this type of grouping. (6/28)

He comments on the difference between his personal learning style and that which he is using during the Institute (cooperative learning):

> My personal learning style seems to be to read about it, see an example and then do

> it...the process in which I have been picking up information here at the Institute is to hear about it and then to explore an activity dealing with a specific area of content thus arriving at certain conclusions of my own. These conclusions are formulated with the assistance of my fellow teachers.

During the second week of the Institute, Fred like Dee and others worries about the focus of the group project and decides to stop by his school to pick up a copy of the science "scope and sequence" for his grade level. At the same time, he writes:

> I want to utilize the cooperative model for implementing this project so...(7/6)

By July eleventh, Fred feels better about the group project:

> We had a very good group session (project) and seemed to get quite a bit of information down on paper. We are very sure of our direction. We must fine tune the steps along our path.

> On July 13th, he thanks a staff member for providing focus to the project --

> We had kind of slipped off the mark a tad.

Shortly before the children are to come and the project is to be implemented, Fred has some doubts about discovery-oriented cooperative learning:

> I think all of us are rather concerned with the non-teacher directed aspect of our project. However, we are united in going by the seat of our pants...let it go and see just what the kids will come up with. (7/19)

During the activity, Fred was surprised that students did not use materials as he expected. He had to almost physically restrain himself from "jumping in" to give information rather than wait to determine if the children would construct that information. (videotape) At the end of the Institute, Fred indicated that he was comfortable when his students talked and worked together. He understood the aims of the Institute. He felt that asking open-ended questions and stimulating students' thinking were the best ways of increasing students' learning. He felt that having support in the classroom was crucial to his effectiveness in the coming year (money for materials, an aide in the classroom, better facilities, time to organize and plan, time to observe, time to meet with other teachers.) He felt it would be most helpful if someone from Institute could observe his class and provide feedback. By contrast, Dee gave this a low priority. Fred was enthusiastic, felt he had learned a lot, but was less confident than Dee, because he had done little of this type of teaching in the past, and felt more need for support. He and Dee both felt that they would like to observe other teachers. They also both scored highly on self-efficacy questions. At

of children -- a feeling in the room of comfort. A teacher who is interacting with the students." (questionnaire 8/2) He considers "digressing" from the task to be the greatest possible disadvantage. At the end of the Institute, Fred had just begun to gain techniques for implementing cooperative learning. He cites Cohen's model as the one he would like to try in his classroom, highlighting role definitions and "grouping for success."(8/2) While Fred's responses on the post-questionnaire do not indicate as high a degree of knowledge in cooperative learning as those given by Dee, his responses are in marked contrast to those he gave on the pre-questionnaire. At that time, he did not mention cooperative learning, but responded only in terms of student/teacher. For example, in response to a question concerning possible strategies to provide interesting learning opportunities for less capable students, Fred wrote:

> May sound terrible, but they get to be with me more!" (nearer his desk)

In response to the same question at the end of the Institute, Fred writes:

> Grouping the children must be done with this in mind. All kids can be successful if given the right environment.

In December, a trained observer noted the following in Fred's sixth grade classroom:

> The seats were arrange in six different groupings. On the back wall huge letters spelled out the slogan "No one of us is as smart as all of us." Two other signs posted underneath read: "You have the right to ask for assistance. You have the duty to assist when someone asks for help. Each person has a part to play. Each person's part is necessary to the final product."

Students had been assigned roles as facilitators, recorders, observers, and materials' persons. In small groups, they carried out a science lab to separate acids from bases. (a concept touched on in the Institute, but this particular lab was not done in the Institute) The observer's final comment:

> I think that the experiment was successful from a content standpoint because of the level of questions asked at the end. One boy asked if he could bring in some samples from home to be tested -- obviously this activity had sparked his curiosity. I also thought that the group participation went well, although in some groups it was difficult to determine the facilitator. But the lasting impression was that group work can be an effective way to run a science lab smoothly and create a desire to explore. (12/14)

There were 33 students in the class. Fred's attitude toward and implementation of cooperative learning unfolded during the interview. He acknowledged that this was his first

year doing cooperative learning, and that his education in this area came from the Institute. He began his school year by getting information from children's former teachers on their abilities in math and reading, then used a computerized program to establish heterogeneous groups which he later fine tuned. He did some initial group dynamics' training with the students (broken circles, jigsaw puzzles, "Guess My Rule"), but felt he should have done more. At midyear he reported that some students were still uncomfortable with cooperative learning, and , in the beginning, all wanted more structure. He explained to the children that he expected them to think rather than memorize or give back facts. He reports that the "pros" are that (most) "kids like it," they are "on-task a lot," and "involved." This is a particularly positive finding since, at the end of the Institute, Fred was concerned that "digression" from the task might be a drawback in cooperative learning. He cites "noise level" and amount of preparation as "cons" to cooperative learning. He says he "feels comfortable with managing groupwork, but it is hectic, sometimes gives him a headache!" (Interview, 12/12)

Sally. In contrast to the other teachers described above, Sally was more reserved. She wrote less about herself as a learner and was skeptical about the use of group work. In May she taught a group work lesson when the observer watched, but she did more direct teaching and hovering than any of the other teachers. She wrote:

> The activities do bring to mind long forgotten concepts and vocabulary but ---it is still rather confused. I'm finding it hard to organize all the ideas. I feel more comfortable with fewer shades of grey. (6/28)

Sally liked to deal with information that had clear attributes of "right" and "wrong." At the beginning of the Institute she was asked how she would give feedback to improve students' learning. She replied that it would be necessary to provide clear expectations and goals and to ask them questions that would help them see their errors and prompt them to explain their reasoning.

Later, she expressed frustration when she planned her Institute project:

> I'm having some difficulty organizing my portion of the project but hopefully it will come together in some usable fashion. (7/11)

She wrote little in her journal. Her entries after the practicum show mixed commitment and little enthusiasm.

> The past three afternoons have proven conclusively to me something I have always suspected. I never ever want to teach "little pumpkins." I did not know where to start with them nor where to go. Endure became my goal. Fourth and fifth graders are the best. That is a fact I have always known. The activities and approaches that I had planned were definitely geared for the intermediate level. To plan anything for

> the primary level would require a whole different avenue. Bless the primary teacher! How do they do it? (7/26)

Sally was willing to assign roles to group members and to use groups. However, she has an overriding concern that the students must acquire certain knowledge predetermined by the teacher.

> This year I will assign or have people take specific roles. (8/3)

> I will probably not feel comfortable doing a total discovery approach at first but will use a more guided aspect. Hopefully, as I become more comfortable with the approach and tighter in my planning I will be able to guide less. But what happens when they don't get the anticipated concept? (8/3)

At the end of the Institute, her answer to the question, What are some disadvantages of having children talk and work together? was revealing:

> I don't get to be chief. They are noisy. They may not discover exactly what I had in mind.

She worried about the noise when students talked and worked together. In March, nine months after the end of the Institute, she said:

> Noise level can be distracting to some students. Some digress from task and cannot always get back on track.

When asked in March, following the Institute, how she would provide learning opportunities for "less capable" students, she said:

> Giving them an area of the assignment that they can successfully complete. Create a model periscope in conjunction with someone else's report.

Sally did not seem to understand that the science activities, with their rich materials, offered her (as teacher) many opportunities to recognize and praise students for demonstrating important abilities besides reading and mathematics. Instead, she seemed to have a unidimensional conception of intelligence consistent with her discomfort for the "gray areas." For Sally, students had high overall intelligence or low overall intelligence. She would view a child who could solve the spatial problems involved in constructing a periscope, but who could not read proficiently, as a child with inferior intelligence who would only serve as the periscope engineer to illustrate a "brighter" child's written report.

After nearly a full year of using the new approach for cooperative group work, Sally had adopted some of the routines and had added them on to her standard operating

procedures. She assigned roles and placed children in small groups for science. However, she persisted in providing excessive help and directions for solving problems ("hovering"). She fretted about children who might not "get" the concepts she wanted to teach. She did not trust children to learn as much in groups as they might in classroom settings where the teacher lectures and where there are clear right and wrong answers. To be sure, she remained uncomfortable with ambiguities and the many gray areas of teaching and learning by discovery.

Discussion.

Differences in implementation. Although no interventions were introduced to teachers by the researchers during the academic year (other than two workshops), and no feedback was provided to teachers on their classroom performance; the quality of their group work implementation differed dramatically. Routine use of roles and heterogeneous groupings were uniform across all classrooms. Kate and Dee augmented the group work routines with many non-routine teaching strategies. For example, when Kate was observed teaching tessellations in mathematics, she circulated among the groups asking appropriate questions that stimulated children's thinking. Occasionally, she praised a child for innovative problem solving. Kate told the researchers, late in the academic year, that she was aware of broad changes in her understanding of group work and her ability to let children discover and construct their own knowledge.

Like Kate, Dee intervened strategically when she saw that children needed extended activities. Dee had come to the Institute with some experience in group work, and she reported making few changes. Observers reported that Dee, like Kate, stimulated thinking and extended activities without "hovering." Dee suggested that future inservice programs might make more extensive use of participants' expertise.

Fred had come to the Institute with no experience in group work whatsoever. At first he expressed skepticism concerning the academic promise of group work. Later, in his classroom, he posted the group work slogans on the walls of his classroom and split his students into groups, assigning to them group roles. During implementation, he reported frustration and a few headaches. In the classroom Fred had trouble refraining from direct instruction, but he was self-critical and he tried to adopt group work techniques.

Sally was typical of more resistant teachers who employed some of the outward, routine forms (groups, roles) but lacked some of the inner, non-routine grace (talking about multiple abilities, extending activities, etc.). In her classroom at the end of the year, she still relied upon direct instruction during all phases of group work (orientations, learning center activities, and whole-class wrap-up). She told children what to look for, explained activities fully in advance (leaving little room for discovery), answered questions directly, and helped whenever she could.

Differences in teachers' response to Institute. Three major differences were found in teachers' responses to the Institute. First was the extent of their own willingness and ability to learn in groups. Second was the character of their musings and reflections on their own learning process as they grappled with science and mathematics content in the Institute and as they struggled with their project group to plan for the Institute's practicum. Third was the degree of enthusiasm they displayed for learning throughout the Institute.

First, teachers' willingness and ability to make use of groups for obtaining assistance varied. During the Institute, when Kate and Dee felt joy or frustration, they shared their feelings with family groups at home. Kate sought help with science concepts at home around the dinner table. Dee told her husband about the Institute for a full hour and a half car ride. "I was full of it," she exclaimed excitedly in her journal. Both Kate and Dee interacted frequently with their project groups and negotiated plans. On the contrary, Sally was not nourished by groups. At the height of her frustration with science content, she returned to her school's library and sat by herself, reading books to glean information. She saw herself as an independent worker and prepared her part of the project group's presentation mainly alone.

Second, teachers' reports of their own learning and their ability to view themselves objectively as learners varied. Kate's comments reveal a penchant for learning in groups:

> I really enjoy the format of the Institute. The time passes quickly and I'm gaining more confidence in myself as a learner. I'm not as "brain" dead in science and math as I once thought. (7/7)

and later:

> I learned a great deal about myself as a learner and as a teacher during this Institute. I discovered that I learn best when I have the opportunity to work with other people about my discoveries and conclusions. (8/3)

As a learner and as a teacher, Kate displayed willingness to grapple with uncertainty, to reconsider which concepts "are truly important in each content area." Sally disliked ambiguity, feeling "more comfortable with fewer shades of grey." Her only comment about herself as a learner was in reference to herself as a "slow learner." She wanted to be sure her students learned what she intended. She returned frequently to the theme, "But what happens when they don't get the anticipated concept?"

Third, the enthusiasm teachers displayed for learning varied. All of the teachers expressed worries at the beginning of the Institute, but as time passed differences emerged. Sally made few positive comments about herself, about her interactions with other participants, and about the Institute. Fred was skeptical at first but became more interested and accepted ideas with increasing ease after application to the project and after experience

with the practicum and with his own classroom. Kate remained enthusiastic throughout the year, although she, too, had fears about her own inadequacies at the beginning of the Institute. Dee, too, was enthusiastic throughout.

Implications.

Implications for staff developers. Three issues for staff developers emerge from this study: selection of teachers for participation in staff development programs, use of stress points, and feedback. First, should opportunities for staff development be limited only to those teachers who are most likely to benefit? Should teachers' prior expertise be assessed so that those with more experience and knowledge about offerings can assume leadership roles in the staff development program? Should those who are resistant be excluded? Or should resistant teachers be identified and given special help?

Second, in view of the stress points within programs, should staff developers anticipate those points and help teachers accommodate? Teachers could be prepared to recognize frustration as an opportunity for learning. They could learn to focus their reflections on what they learn rather than the negative aspects of the frustration.

Third, should scarce resources prevent the inclusion of follow-up and feedback? Previous studies show how powerfully feedback can change implementation (Ellis, 1990), even when instruction has not changed teachers' knowledge base (Ellis & Lotan, 1991). In this study, when Kate received video feedback at the end of the year of implementation, she was surprised to see some of the teaching behaviors of which she was unaware. She remarked that the feedback helped her immeasurably.

Implications for researchers. Among many research implications of this study are two that are especially interesting: the meaning of apparent surges of learning during the inservice program and the stability of some teachers' beliefs and understandings throughout the Institute and following year of implementation. First, teachers' reports of learning surges and changes in belief were preceded by periods of frustration; and those periods of frustration were precipitated by program demands that teachers apply difficult new concepts to planning and practice. This finding is consistent with the theoretical framework that suggests a sequence in which belief follows teachers' practice and realization that practice was successful. In the present study teachers first applied new concepts to planning a form of practice. Later they applied new concepts to teaching in the practicum and in their own classrooms. The most dramatic changes in belief occurred after the practicum, but some changes were seen after the group project was completed and before the practicum. The important new finding was that teachers reported severe frustration, confusion, and even "headaches" (Fred) when they anticipated application of the new concepts. Future researchers might examine the issue more closely to find out more about the relationships between stress, practice, and changes in belief and knowledge. The phenomenon is reminiscent of the familiar Piagetian accommodation-assimilation sequence in learning.

The second issue for researchers is the stability of some beliefs from the beginning of the Institute to the end of the first academic year. Teachers answered identical questions, intended to display their knowledge and beliefs about cooperative learning, at the beginning and end of the Institute and again in March of the following academic year. Many of their answers changed from beginning to end of the Institute, but then reverted to their original state by the following March. Old habits of thinking persist. Would more consistent follow-up and feedback help to stabilize new knowledge and beliefs?

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